CLAIMS:

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What is claimed is:

A method of operating a thermal processing system comprising:
 positioning a wafer for processing by the thermal processing system on a
 hotplate comprising a plurality of zones;

creating a dynamic thermal model of the thermal processing system;

establishing a plurality of intelligent setpoints using the dynamic thermal model of the thermal processing system, wherein each of the plurality of intelligent setpoints is associated with a corresponding one of the plurality of zones; and

controlling an actual temperature of each of the plurality of zones of the hotplate using a corresponding one of the plurality of intelligent setpoints to establish a substantially uniform temperature profile across the wafer during processing.

2. The method of claim 1 further comprising:

receiving feed forward data;

estimating wafer stresses using the feed forward data;

creating a thermal model for a gap between the wafer and the hotplate, wherein

a thermal response for the gap is predicted based on the estimated wafer stresses; and
incorporating the thermal model for the gap into the dynamic thermal model of
the system.

- 3. The method of claim 2 wherein wafer stresses are estimated using refractive index (n) data and extinction coefficient (k) data extracted from the feed forward data.
- 4. The method of claim 2 wherein the feed forward data comprises layer information including at least one of the number of layers, layer position, layer composition, layer uniformity, layer density, and layer thickness.
- 5. The method of claim 2 wherein the feed forward data includes at least one of critical dimension (CD) data, profile data, and uniformity data for the wafer.
- 6. The method of claim 2 wherein the feed forward data includes at least one of critical dimension (CD) data for a plurality of locations on the wafer, profile data for a plurality of locations on the wafer, and uniformity data for a plurality of locations on the wafer.

- 7. The method of claim 2 wherein the feed forward data includes a plurality of locations radially positioned on the wafer.
- 8. The method of claim 2 wherein the feed forward data includes a plurality of locations non-radially positioned on the wafer.
- 9. The method of claim 1 further comprising:

 examining a real-time response of the wafer and the hotplate;
 estimating wafer stresses using the real-time response; and

 5 creating a thermal model for a gap between the wafer and the hotplate, wherein a thermal response for the gap is predicted based on the estimated wafer stresses; and incorporating the thermal model for the gap into the dynamic thermal model of the system.
 - estimating wafer warpage; and
 creating a thermal model for a gap between the wafer and the hotplate, wherein
 a thermal response for the gap is predicted based on the estimated wafer warpage; and
 incorporating the thermal model for the gap into the dynamic thermal model of
 the system.

The method of claim 1 further comprising:

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11. The method of claim 1 further comprising: modeling a thermal interaction between the zones of the hotplate; and incorporating the model of the thermal interaction into the dynamic thermal model of the system.

- 12. The method of claim 1 further comprising:
 creating a virtual sensor for estimating a temperature for the wafer; and
 incorporating the virtual sensor into the dynamic thermal model of the system.
- 13. The method of claim 1 further comprising:

 modeling a thermal interaction between the hotplate and an ambient

environment; and

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incorporating the model for the thermal interaction into the dynamic thermal model of the system.

- 14. The method of claim 1 further comprising:

 creating a diffusion-amplification model of a resist carried by the wafer; and
 incorporating the diffusion-amplification model into the dynamic thermal model
 of the system.
- 15. The method of claim 1 wherein establishing the plurality of intelligent setpoints further comprises:

creating a variation vector D, wherein the variation vector comprises differences between measurement data and a desired value;

parameterizing at least one nominal setpoint into a vector R comprising at least one intelligent setpoint;

creating a sensitivity matrix using the dynamic thermal model; and determining the at least one intelligent setpoint by solving an optimization problem comprising

 $\min_{r} \|D - \alpha \cdot MR\|,$

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wherein $r_{min} < r < r_{max}$, R is the vector comprising the at least one intelligent setpoint, M is the sensitivity matrix, α is a proportionality constant relating the measurement data to the sensitivity matrix M, and D is the variation vector.

- 16. The method of claim 15 further comprising:
 updating a recipe with the plurality of intelligent setpoints;
 running the updated recipe;
 obtaining updated measurement data; and
 iterating until a desired uniformity is achieved.
 - 17. The method of claim 16 wherein the desired uniformity comprises a 3-sigma variation of less than approximately two percent.
 - 18. The method of claim 17 wherein the desired uniformity comprises a 3-sigma variation of less than approximately one percent.
 - 19. The method of claim 15 further comprising:

receiving feed forward data;

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obtaining the measurement data from the feed forward data, wherein the measurement data comprises at least one of critical dimension measurements, profile measurements, and uniformity measurements; and

determining the desired value, wherein the desired value comprises at least one of desired critical dimension, a desired profile, and a desired uniformity.

20. The method of claim 15 further comprising:

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executing a process using a recipe having at least one nominal setpoint for each zone of the hotplate;

obtaining the measurement data from the executed process, wherein the measurement data comprises at least one of critical dimension measurements, profile measurements, and uniformity measurements; and

determining the desired value, wherein the desired value comprises at least one of desired critical dimension, a desired profile, and a desired uniformity.

21. The method of claim 15 further comprising:

making temperature perturbations for each zone of the hotplate; and establishing the sensitivity matrix M using results of the temperature perturbations.

22. The method of claim 15 further comprising: using an instrumented wafer to establish the sensitivity matrix *M*.

23. The method of claim 15 further comprising:

determining a vector D of the thermal dose at each radial element location, wherein

$$D = \begin{bmatrix} d_1 \\ \vdots \\ d_n \end{bmatrix}; \text{ and }$$

characterizing the resultant perturbations in the thermal dose as

$$\begin{bmatrix} d_1 \\ \vdots \\ d_n \end{bmatrix} = M \begin{bmatrix} r_1 \\ \vdots \\ r_n \end{bmatrix}; \text{ and }$$

determining values of vector r, such that the resultant d removes the across wafer variations in the variation vector D.